point of which is the minute adaptations of structure to function, an illustration of a kind of research which is always welcome and valuable.

W. E. Ritter discusses the structure and affinities of a new type of Ascidian from the Californian coast, which he calls Herdmania after a well known ascidiologist. The colony is composed of crowded but entirely free zooids arising by budding from short, much branched, closely interwoven stolons. The zooid is long and narrow, with three regions—thoracic, digestive, and cardiogenital. It is quite unique in having two epicardiac tubes, separate throughout their length; the oviduct serves as a uterus in which the embryos go through their development to nearly the period of metamorphosis; there is a peculiar grouping of the numerous branchial tentacles. It seems to be a divergent offshoot from the Polyclinid branch. R. M. Strong brings us back to a familiar subject and an old problem; he analyses the iridescence or metallic coloration of the dorsal surfaces of the distal portions of the feathers from the sides of the neck of grey domestic pigeons. The coloration is not due to diffraction, and Gadow's refraction-prism hypothesis will not work. The colours are probably thin-plate interference colours or Newton's rings, effects which are produced where spherical pigment granules come in contact with the outer transparent layer. C. R. Eastman takes us back to Palæozoic sharks, showing that the much-debated Edestus fossils are genuine teeth, and represent a stage in an interesting evolution series from Campodus to Helicoprion. We can hardly do more than refer to H. V. Neal's careful study of the development of the ventral spinal nerves in Selachians, but we may note that while the neuraxones of these nerves develop like those of Amniota as processes of neuroblast cells, there is a migration of medullary cells in early stages of development, which, though they take no part in the formation of the neuraxones or ganglia of the ventral nerves, participate in the formation of the nerve-sheaths, which have usually been regarded as of mesenchymatous origin.

H. S. Jennings elaborates his interesting thesis that the asymmetry of most flagellate and ciliate Infusorians, as also of the Rattulid Rotifera, is correlated with the habit of swimming in spirals. The spiral course is the simplest device for permitting an unequally balanced organism to progress in a given direction through the free water, and the method of reaction to most stimuli is closely correlated with the unsymmetrical or spiral type of structure. Rolfe Yorke contributes a study of the nerve cells of the cockroach and of the substance within these that seems to correspond to the chromophilous material in the nerve cells of higher animals. R. M. Yerkes shows by elaborate experiments that *Daphnia pulex* is strongly positively phototactic to all intensities from 0 to 100 candle-power, and is negatively thermotactic at a temperature of about 28° C.

In a very interesting paper on Mendel's law and the heredity of albinism, W. E. Castle and G. M. Allen show that complete albinism, without a recorded exception, behaves as a recessive character in inheritance, and that the facts are in general accord with Mendelian principles. P. E. Sargent discusses the structure and functions, development and phylogeny of that archaic portion of the mesencephalic roof known as the torus longitudinalis which is characteristic of Teleosts. T. G. Lee attacks a not less difficult problem —the implantation of the ovum in the gopher, which he finds to be quite unique as regards the nature and history of the pre-placental "fixation-mass" formed by the trophoblast. J. H. Gerould makes a comparison of the early stages of Sipunculus and Phascolosoma, and seeks to show that the "serosa" of the former represents the remains of a degenerating prototroch equivalent to that of the latter, which is in turn homologous with the primitive condition seen in mesotrochal Annelids.

G. H. Parker takes us once more into the open air in his study of the positive and negative phototropism of the mourning-cloak butterfly (*Vanessa antiopa*). It is interesting that the negative phototropism is only seen in intense sunlight and after the butterfly has established a certain state of metabolism by flying about for a while, and that the position assumed in negative phototropism exposes the colour patterns of the wings to fullest illumination, and has probably something to do with bringing the sexes together during the breeding season. Ida H. Hyde presents a new interpretation of the structure of the eye of Pecten, supplementing and correcting previous descriptions. The long series of memoirs ends with one by H. B. Ward on the larvæ of *Dermatobia hominis* —an Oestrid or bot-fly, widely distributed in America, though not in the States, which occurs commonly in the skin of cattle, pigs, and dogs, and less frequently in some other creatures, including—unfortunately—man.

We cannot conclude our rapid review of this huge volume without directing attention to the great range of zoological territory which the memoirs cover, to the high standard of workmanship which they exhibit, and to the unanimity with which the various authors recognise their indebtedness to their master, Edward Laurens Mark. J. A. T.

## *SYNTHESIS OF VITAL PRODUCTS.*

*The Chemical Synthesis of Vital Products, and the Inter-relations between Organic Compounds.* By Prof. Raphael Meldola, F.R.S. Vol. i. Hydrocarbons, Alcohols and Phenols, Aldehydes, Ketones, Carbohydrates and Glucosides, Sulphur and Cyanogen Compounds, Camphor and Terpenes, Colouring-matters of the Flavone Group. Pp. xvi+338. (London: E. Arnold, 1904.) Price 21*s.* net.

IN spite of the long and daily increasing list of successful chemical syntheses of substances which are primarily produced as the result of processes occurring in living organisms, one constantly hears from physiologists the complaint that the synthetic work of chemists, wonderful as it may be in itself, throws no light on the biochemical problem of how the same substances are generated in the bodies of plants or animals. The points of view of the organic chemist and the physiologist are entirely distinct. The chemist, in studying a biochemical product, starts by dissecting it into a number of known atomic groups, and when this analytic work is complete, he seeks to confirm his conclusions as to the constitution of the substance by piecing these atomic groups together again, so as to reproduce the substance synthetically. In accomplishing the latter part of his task, the question of imitating biochemical conditions never even occurs to him, inasmuch as for his purpose the simplest and most efficient laboratory processes are the best; and when he has solved the problem from his point of view he is satisfied. That alizarin and indigo can not only be synthesised, but that they can be synthesised so cheaply that the natural products cannot compete with them in the market, is doubtless a triumph both for the chemist and for the technologist; but so long as each step of these syntheses is effected either by means of such chemical agents or under such conditions of temperature as would be fatal to life in any form, it is evident that the results are devoid of any biochemical bearing, and that the physiologist is justified in disregarding them. Meanwhile, therefore, so far as the important subject of the synthesis of vital products is concerned, there is no helpful interaction between chemistry and physiology. Each goes its own way.

It is with the object of endeavouring to remove this reproach from these sciences and of bringing about a better understanding between them that Prof. Meldola has written the present work, of which the first volume is now before us. The work is, as the author states, "a record of the synthetical achievements of generations of workers arranged with a distinct biochemical bias." In fact, the title of one of the introductory chapters, "Organic Chemistry from the Bio-centric Standpoint," might have served as a subtitle for the entire work.

This biocentric standpoint has, as the author indicates, necessitated an arrangement of the subject-matter differing materially from that usually followed in works on organic chemistry. In these the derivatives are arranged under the parent compound, or chemical type, from which in many cases they can be produced by processes of laboratory synthesis. But,

> "According to the present scheme each vital product is in itself a biochemical type quite independently of the chemical type to which it may be referred, and the synthesis of each product, instead of being mentioned incidentally in connexion with the group to which it belongs as a point of minor interest, is here brought into the first rank of importance. In other words, the chemical type is in this work subordinated to the individual compound—a mode of treatment for which every justification will be conceded when it is pointed out that in vital syntheses there are unquestionable genetic relationships between compounds of quite different types" (p. 12).

Another necessity arising from the biocentric standpoint has been the recognition of "down-grade synthesis" as well as of "up-grade synthesis"—of the synthetic products obtained from complex generators by fission as well as of those obtained from simpler generators by union. Thus a number of substances generally recognised as vital products do not occur as such in the living organism, but are produced by hydrolytic fission, sometimes during the process of isolating them: thus alizarin from the glucoside ruberythric acid. The justification for registering these as vital products lies in the fact that their atomic complexes are pre-existent in the glucosides and similar compounds from which they are obtained.

The details of these classifications are worked out by the author with very great skill and with exhaustive knowledge of the subject. References are everywhere given, no fewer than forty-five periodicals, not to mention the patent literature, being quoted from. Among the syntheses enumerated we have not succeeded in detecting any omissions. The author does not claim to have sifted critically the enormous mass of experimental records which he has brought together; he leaves to the investigators themselves the responsibility for their statements. His object is "to bring practical workers, whether chemists, physiologists, or technologists, into communication with the various authorities quoted."

The author admits that we are at present profoundly ignorant of the modes of synthetic action which go on within the living organism, and he points to the necessity for a more systematic study of the chemical stages in which such action occurs—a branch of investigation for which plant life offers especial facilities. He points to Charabot's researches on the development of the terpene alcohols and ketones as examples of the pioneering work required. He is firm in his belief that such work will not only increase our knowledge of biochemistry, but will place us in a position to imitate the conditions of biochemical synthesis. He writes:—

> "If, some decades hence, a work on similar lines to the present should ever be compiled, it may be anticipated with confidence that the laboratory methods for synthesising vital products will have approximated more closely to the physiological processes" (p. 9).

This confidence in the future powers of the chemist is closely connected with the author's attitude towards Neovitalism. He says:—

> "I think it advisable to place on record the opinion that the present achievements in the domain of chemical synthesis furnish no warrant for the belief that the chemical processes of the living organism are in any sense transcendental, or that they must be regarded as belonging to a class of special material transformations which human science will never be able to reproduce. Such an admission as the latter would be tantamount to a proclamation of Neovitalism. . . . There is no warrant for the belief that the physics or chemistry of animals and plants is ultra-scientific" (Preface, p. vi).

To the present reviewer the terms "transcendental" and "ultra-scientific" seem to beg the question. It is surely a matter for legitimate and entirely "scientific" inquiry, whether our present laws of chemistry and physics, which have been deduced solely from the study of dead matter, apply without qualification to living matter. Possibly, when the conditions of the biochemical problem are more thoroughly understood, it may be, contrary to Prof. Meldola's belief, just as easy to show that we can never, in our beakers and retorts, imitate the biochemical conditions of vital synthesis as it is for a mathematician to prove the transcendence of π.

This view, like its opposite, is, however, in the present state of our knowledge, rather a matter of opinion than of proof.

In conclusion we congratulate the author on having produced a most useful work—a work of almost ultra-German thoroughness—and one which will be an immense boon to all interested in the subject with which it deals.

## *IONISATION AND ABSORPTION.*

*The Becquerel Rays and the Properties of Radium.* By the Hon. R. J. Strutt. Pp. vii + 214. (London: Edward Arnold, 1904.) Price 8*s*. 6*d*. net.

A NUMBER of books dealing with radio-activity and the kindred phenomena have already appeared; and it is a bold thing on the part of an author to place another before the public. However, with the exception of Prof. Rutherford's inimitable treatise on the subject, none of the previous works have been characterised by any striking individuality, so that there is, or rather was, still room for a vigorous statement of the general features of the subject from a popular point of view. This the author of the present work has accomplished in a manner that leaves little room for criticism. He possesses to a remarkable degree the faculty of stating difficult questions in a simple way, and of expressing the answers in a language which is easily understood.

In a book of this kind there is usually a good deal of treatment which appears somewhat slipshod when regarded from a strictly scientific standpoint; but such a charge cannot with justice be maintained against the present volume. Naturally some of the most intricate points, such as the effect of a magnet on a moving electric charge, have to be treated analogically to make them represent anything real to a mind inexpert in dealing with this class of phenomena; but here the author has not only been fortunate in choosing familiar instances, but those chosen have been true analogies, and accurately represent the physical features of the case. The whole treatment is characterised by vigour and interest, and is such as we should have every reason to expect from the pen of so well-known an investigator in this branch of physical science as the author.

It is scarcely necessary to analyse in detail the contents of the book, but the whole forms a clear and concise presentation of the great question of the relationship between electricity and matter, which is of overpowering interest to physicists at the present time. In the first chapter we are made familiar with the various phenomena accompanying electric discharge in rarefied gases, and are thus placed in a position to understand the working of what may be regarded as a miniature discharge tube, viz. a radio-active atom. After describing the various manifestations of radio-activity and the properties of the radiations, the author considers the various products of radio-active change. We are thus led to a probable view of the mode of origin of the chemical elements, in the evolution of which the inert gases seem to form the final stage. The last chapter forms a very lucid account of the electrical theory of mass and the various views of atomic structure based thereon.

Unfortunately there is one serious blot on the general excellence of the book, and that is the treatment of absorption in chapter iv. Almost at the outset (p. 87), the author contradicts himself owing to the word "greater" having crept in where he doubtless intended to say "less." This uncorrected error is not likely to cause much trouble to those who are familiar with the subject, but we imagine the beginner will be greatly perplexed by trying to reconcile this statement with what follows.

Apart from this, it seems a great pity that so much stress should be laid on Madame Curie's experiments on the absorption of the α-rays from polonium, as it is doubtful what conclusion can be drawn from them except that practically all the rays are stopped by about four centimetres of air. In the experiments referred to a quantity of polonium was placed at a variable distance below two parallel plates three centimetres apart. A hole in the lower plate covered by wire gauze allowed the α-rays from the polonium to penetrate the region between the two plates, and the ionisation it produced there was taken to measure its "intensity." Madame Curie then investigated the diminution in the ionisation produced by placing a sheet of aluminium foil 0·001 cm. thick (equivalent to 2 cm. of air) over the lower plate, when the polonium was at different distances below it. When the polonium was 0·5 cm. away the aluminium cut down the radiation to one-quarter its previous value, whilst when the distance was 1·9 cm. the ionisation was reduced to one-twentieth. This shows clearly, as Madame Curie pointed out, that the α-rays which have passed through a certain thickness of matter are less penetrating than those which have not. The question, however, which is of most interest in the present state of the subject is how the ionisation per centimetre of path varies with the amount of matter previously passed through. These experiments furnish no very certain answer to this question, since when the aluminium foil is inserted the whole of the radiation is absorbed long before it reaches the upper plate, so that the different experiments are not strictly comparable. The whole question of absorption is very intricate, and it is undesirable to dwell further upon it here. There is still plenty of room for experimental investigation on this subject. For instance, Townsend's experiments on ionisation by collision and Durack's on that produced by the Lenard and Becquerel rays show that the number of ions produced per cm. by a moving corpuscle increases with the velocity up to a certain point, and then decreases. It would be of interest to see whether, as is probably the case, this holds for the positively charged α-rays as well.

The book contains three useful appendices. The first describes a number of simple experiments illustrating the essential features of radio-activity; the